

## EXECUTIVE SUMMARY

This report documents the development of a spreadsheet tool designed to help the California Air Resources Board (CARB) estimate total reductions in emissions of greenhouse gases (GHGs) for various climate-change mitigation strategies being considered by CARB. The spreadsheet tool is called the California Air Resources Board Climate Change Mitigation Strategy Impact Calculator, or CARB CCM Calculator for short. The CARB CCM Calculator estimates reductions in CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) emissions of GHGs in a user-specified target year and over a user-specified period of years, for each climate-change mitigation strategy. The CARB CCM Calculator estimates reductions for the following mitigation strategies:

Strategy	Description
Cargo-Handling Equipment Anti-idling	Reduce idling (beyond 10 minutes) in cargo-handling equipment at ports and intermodal rail yards.
Low-GWP Refrigerants for Mobile Vehicle Air Conditioning Systems	Low-GWP refrigerants used in mobile air conditioning systems instead of HFC134a
Transportation Refrigeration Unit (TRU) Cold Storage Limits	TRU extended cold storage (beyond 24 hours) is prohibited.
Cool Automobile Paints	Advanced exterior paint and reflective glazing reduces interior temperatures of vehicles, thus reducing air conditioner (AC) use and fuel use.
Low-friction Engine Oil	Low-viscosity oil reduces friction in the engine and thus boosts fuel economy.
High GWP Reduction from Stationary Sources	High GWP Refrigerant Tracking, Reporting, Repair and Deposit for Stationary Refrigeration and Air Conditioning systems and Specifications for New Commercial and Industrial Refrigeration Systems
Alternative Suppressants in Fire Protection systems	Considering GHGs from alternative suppressants in total flooding (fixed) and streaming (portable) fire suppression systems. Most fire suppression systems originally used halons, which are ozone depleting compounds, but new systems have moved to halon alternatives that are high GWP fire suppressants, e.g. HFCs
Foam Recovery and Destruction Program	Reducing the GHG emission from waste insulation foam when it is shredded during appliance recycling or broken during building construction, renovation, and demolition.

The emissions reductions estimated by CARB CCM Calculator are a function of detailed inputs and user-specified scenario variables. The detailed inputs, located in various tabs throughout the spreadsheet, characterize lifecycle emission factors and the phase-in and effectiveness of mitigation measures. The user-specified scenario variables, located on the “Summary” tab, are for the analysis period, the choice of CO<sub>2</sub>-equivalency factors, the choice of emissions scenario, and the choice between default or user-specified rates of adoption of mitigation strategies.

The CARB CCM Calculator is designed to perform relatively simple, transparent calculations involving easily identified key parameters. Hence, the Calculator does not perform original detailed lifecycle calculations itself, but rather relies in key places on lifecycle-emission estimates from other LCA models, such as the Lifecycle Emissions Model and SimaPro. The Calculator can be expanded relatively easily by adding new tabs and new results lines in the “Summary” tab.

The CARB CCM Calculator reports emission reductions and key assumptions on a “Summary” page. The following pages provide an example of the output on the “Summary” page, using the IPCC AR4 GWP values, base-case emission reductions, and user-input adoption/implementation percentages. Note that although the CARB CCM Calculator provides point estimates of emission reductions to several decimal places, these should not be interpreted as “significant” digits. The uncertainty in the estimates of the CARB CCM Calculator is difficult to estimate formally, but based on past experience, in our opinion is likely to exceed 20% and probably 30%.

### Example of output from the CARB CCM Calculator

Climate Change Reduction Strategy	10 <sup>12</sup> g CO <sub>2</sub> e Reduced		Key Assumption(s)	Active Value
	2020	2010-2020		
<a href="#">Cargo Handling Equipment Anti-Idling</a>	0.0001	0.0006	Annual growth rate of cargo equipment	2%
			Yr 1 percent of fleet adhering to regulation	75%
			Annual rate of increase for compliance	10%
<a href="#">Low GWP Refrigerants for New Motor Vehicle Air Conditioning Systems</a>	1.0	5.1	CEF of replacement refrigerant	120
			Leakage (grams) per vehicle per year	40
			Initial adoption in year 2010	50%
			Annual rate of increase for adoption	10%
<a href="#">Transport Refrigeration Unit Cold Storage Limits</a>	0.00	0.03	Annual growth rate of TRUs	2%
			Yr 1 percent of fleet adhering to regulation	75%
			Annual rate of increase for compliance	10%
<a href="#">Cool automobile paints</a>	0.33	1.41	Fuel economy drop with AC: cars	18.2%
			Fuel economy drop with AC: trucks	13.8%
			Percent time AC runs	33%
			Reduction in AC use	26%
			Initial adoption in year 2010	50%
			Annual rate of increase for adoption	10%

<a href="#">Low-friction engine oil</a>	8.6	67	Fuel economy improvement Initial adoption in year 2010 Annual rate of increase for adoption	1.5% 50% 10%
<a href="#">High GWP Stationary Refri.</a>	10.3	110	Refrigerant types in blend Current and future leakage rates Refrigerant recycling rates	see sheet see sheet see sheet
<a href="#">Alternative Suppressants in Fire Protection Systems</a>	12.8	310	HFC-125 HFC-134a HFC-227ea HFC-236fa	25% 25% 25% 25%
<a href="#">Foam Recovery and Destruction Program (Ten Year Model)</a>	146	1,940	Demolition Lost Fraction <i>Blowing Agents Portfolio after 2005</i> HCFC-141b HFC-134a HFC-245fa <i>Blowing agents weight fractions</i> Building Insulation Appliance (refrigerators, freezers) Commercial refrigeration units Transport refrigerated units	15%  40% 40% 20%  4% 4% 4% 4%

<a href="#"><u>Foam Recovery and Destruction Program (Annual Model)</u></a>	19,079	220,433	<b>Demolition Lost Fraction</b>	<b>15%</b>
			<i><u>Blowing Agents Portfolio after 2005</u></i>	
			<b>HCFC-141b</b>	<b>40%</b>
			<b>HFC-134a</b>	<b>40%</b>
			<b>HFC-245fa</b>	<b>20%</b>
			<i><u>Blowing Agents Portfolio from 2000 to 2004</u></i>	
			<b>HCFC-141b</b>	<b>50%</b>
			<b>HFC-134a</b>	<b>50%</b>
			<i><u>Blowing agents weight fractions</u></i>	
			<b>Building Insulation</b>	<b>4%</b>
			<b>Appliance (refrigerators, freezers)</b>	<b>4%</b>
			<b>Commercial refrigeration units</b>	<b>4%</b>
			<b>Transport refrigerated units</b>	<b>4%</b>